NLCD Land Cover Change Product

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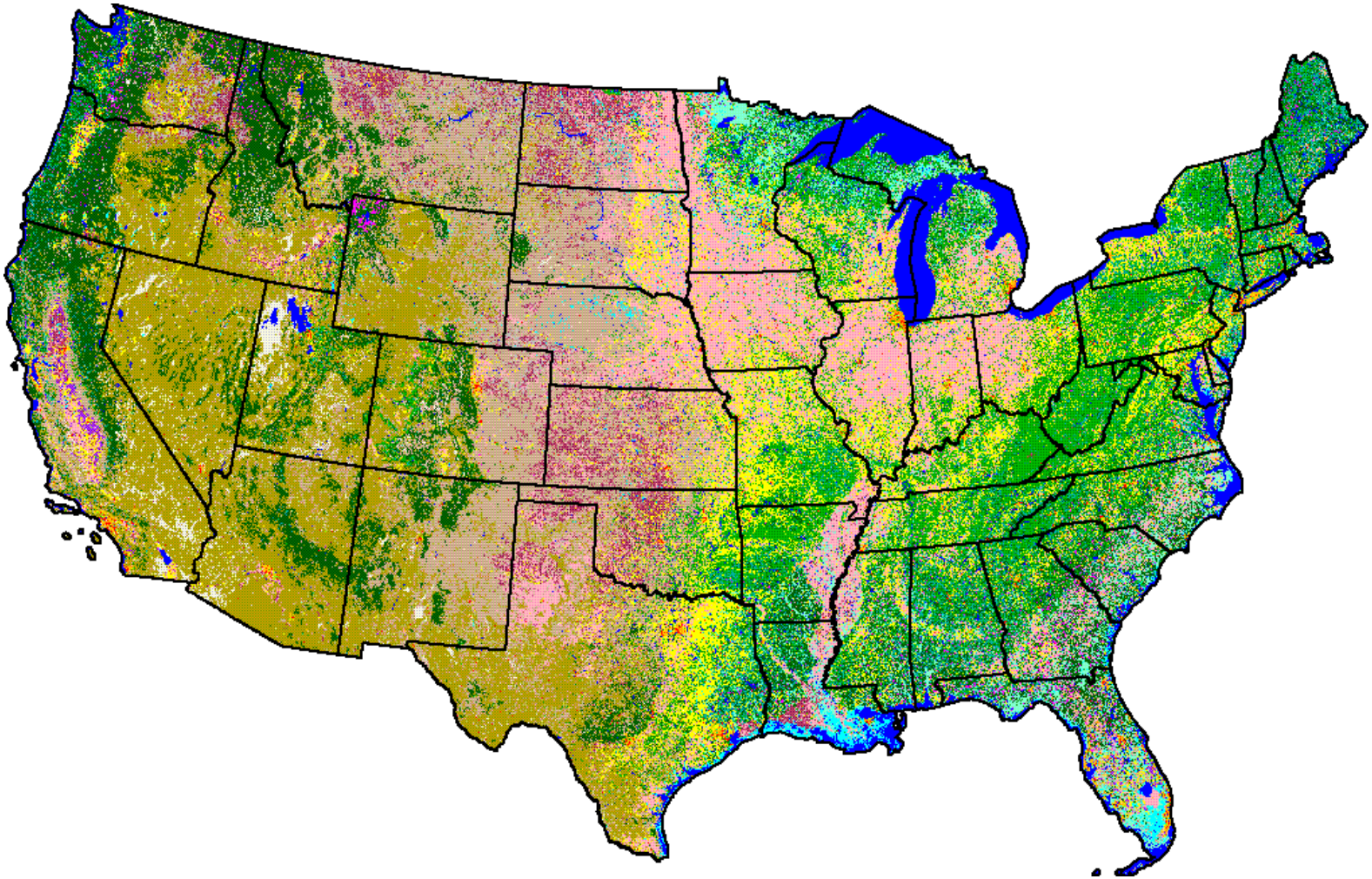
USGS

National Land Cover Dataset 1992



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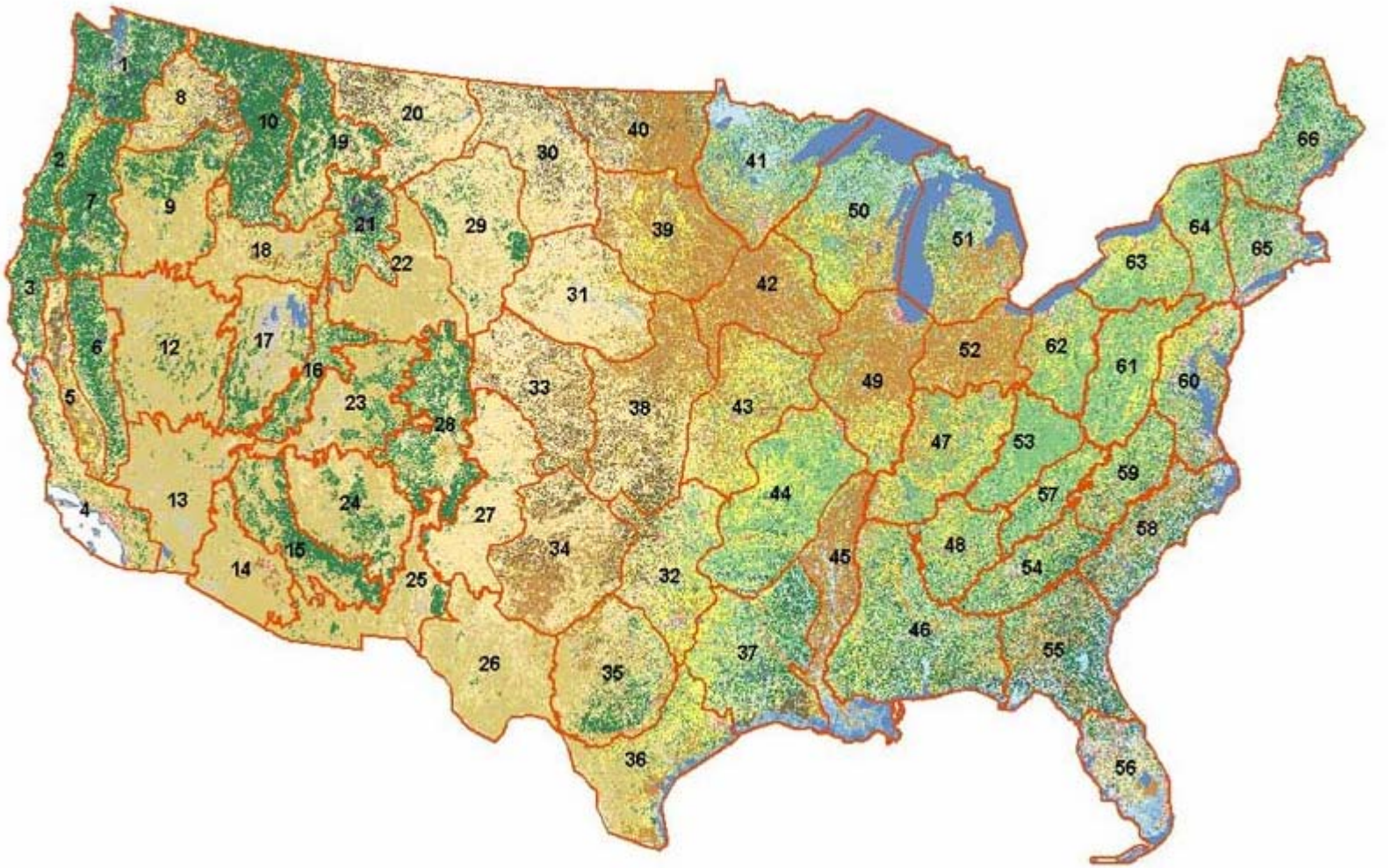
NLCD 2001 Mapping Zones



Multi-Resolution Land Characteristics (MRLC) Consortium (http://www.mrlc.gov/)

MRLC products:

National Land Cover Dataset 1992 and

National Land Cover Database 2001

- **A typical user of both will want to compare them, and find what is different to determine "change".**
- **There may be some problems…**

"A man with one watch knows what time it is. A man with two is never sure."
-- Segal's Law

Problems? Why?

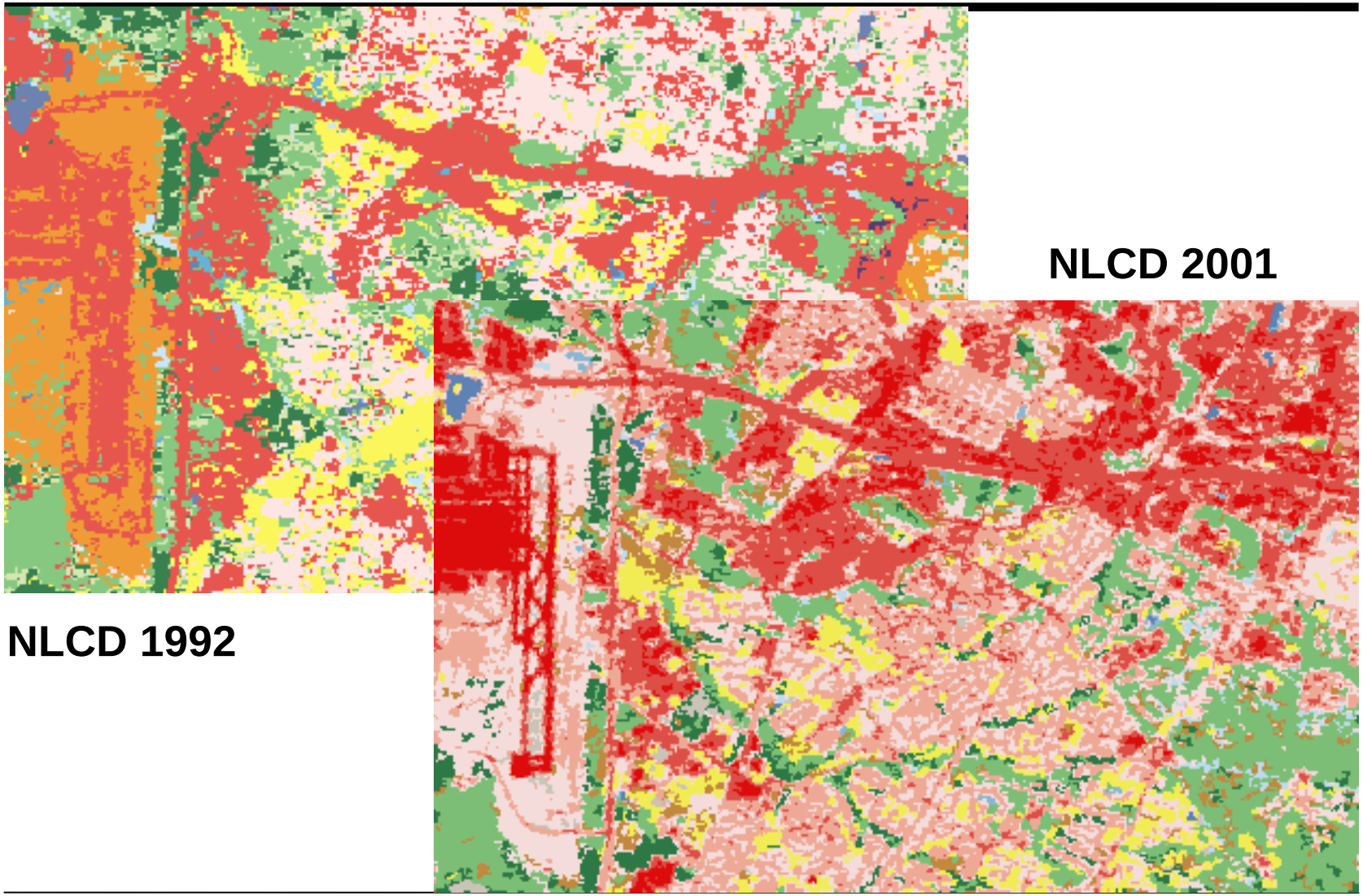
- **Different methodologies –**
  - 1992 methods varied, but typically involved skilled interpretations of results from various clustering algorithms
  - 2001 methods rely on output of decision-tree algorithms

- **Slight changes in class definitions –**
  - 1992 classes involved land use classes, as well as land cover classes: e.g. “transitional barren”
  - 2001 classes are land cover classes, with exception of urban classes, which are inserted from thresholds of a separately derived percent-imperviousness product.

“There is no one ideal classification of land use and land cover, and it is unlikely that one could ever be developed.” -- J.R. Anderson, et al., USGS Professional Paper 964, 1976

USGS

Land Cover Products - Comparison



NLCD 2001

NLCD 1992

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Needed:

An NLCD Land Cover Change Method that addresses all foreseeable concerns, with these added constraints -

- **very low cost**
- **operationally very fast**
- **rigorous and robust**
- **applicable across the entire country**

"There are different perspectives in the classification process, and the process itself tends to be subjective…" – J.R. Anderson, et al

Decisions made to help this process evolve-

- **At the MRLC meeting of 2003, it was agreed to simplify the land cover classes from the approximately 16 classes at Anderson Level 2 (similar to NLCD1992 and NLCD2001) to 7 classes at Anderson Level 1.**

- **At the same meeting, it was agreed that the change comparisons must include re-mapping the 1992 land cover with the 2001 methods**

"Decisions that may seem arbitrary must be made at times."
– J.R. Anderson, et al.

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A few traditional methods for change detection-

- **Visual interpretation of image pairs of different dates**

- **Band comparisons of each image pair, with the differences as a guide to manual interpretations: e.g. red-band differencing accompanied by on-screen recoding**

- **Post classifications, where each scene of a pair is classified into land cover classes, and comparisons are made to those classifications**

"It is rare to find the clearly defined classes that one would like."
– J. R. Anderson, et al.

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NLCD Change Method- Six Major Steps

1) For each mapping zone, compare NLCD1992 and NLCD2001 at Anderson Level 1, to establish areas of agreement.
2) Use these areas of agreement as the source of training pixels to develop a decision-tree classification of the 1992 image mosaic, as well as the 2001 image mosaic.
3) Compare these newly generated Anderson Level 1 classifications to identify “areas of probable change”, versus “no-change”,
4) Filter these areas using each classification’s confidence map to threshold the most confident changes from the least confident, and identify them with “from-to” labels.
5) Use these most-confident areas as training pool for classifying spectral differences, and
6) Create final composite, assembling values from all results.

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NLCD Change Combinations

Primary Classes:

1. **Water**
2. **Urban**
3. **Barren**
4. **Forest**
5. **Rangeland**
6. **Agriculture**
7. **Wetland**
8. ***Perennial Ice/Snow***

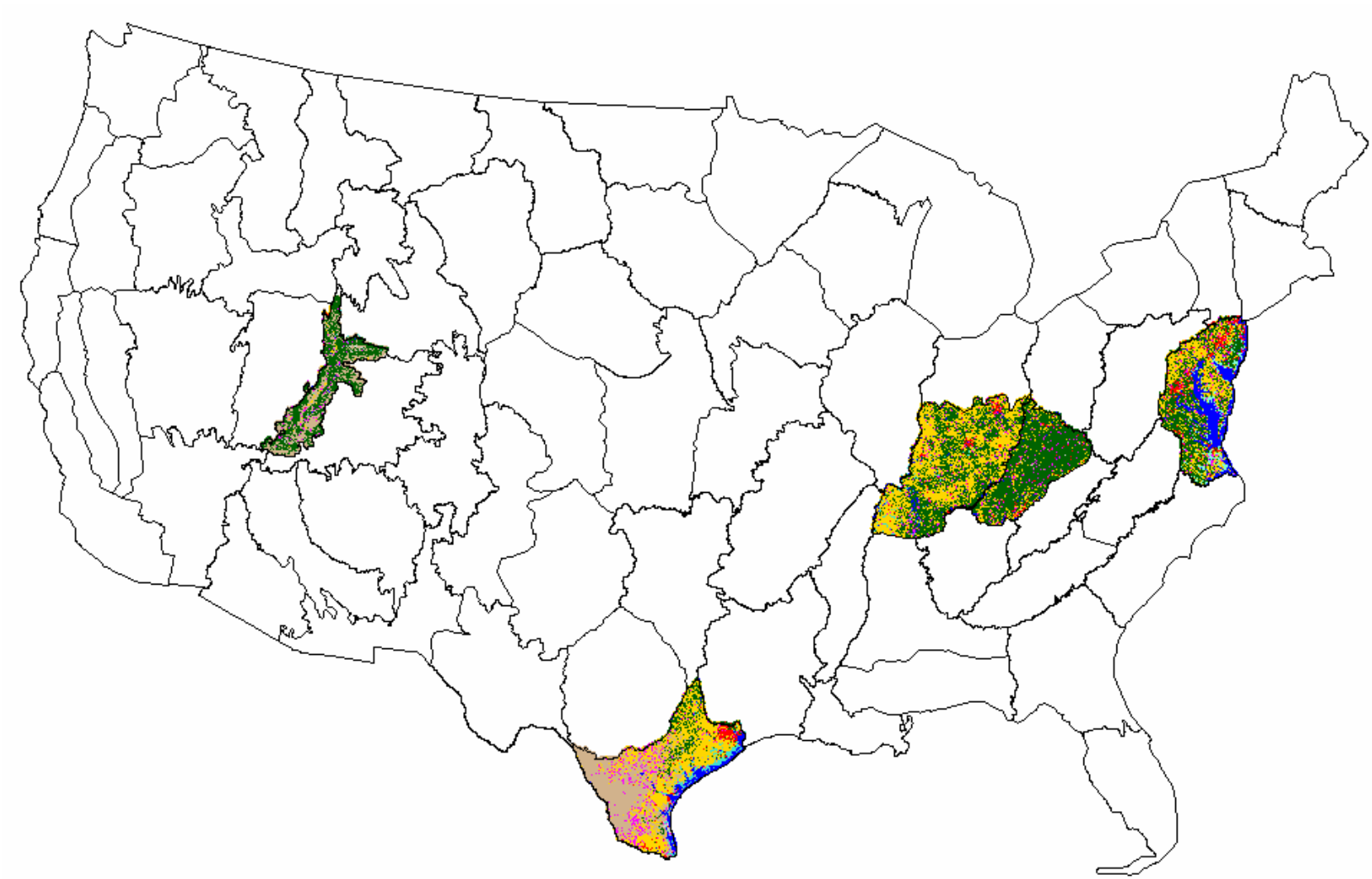
1	Water
2	Urban
3	Barren
4	Forest
5	Rangeland
6	Agriculture
7	Wetland

Change Classes:
By From-To Combination
Eg: From Forest(4) to Barren(3) = 43

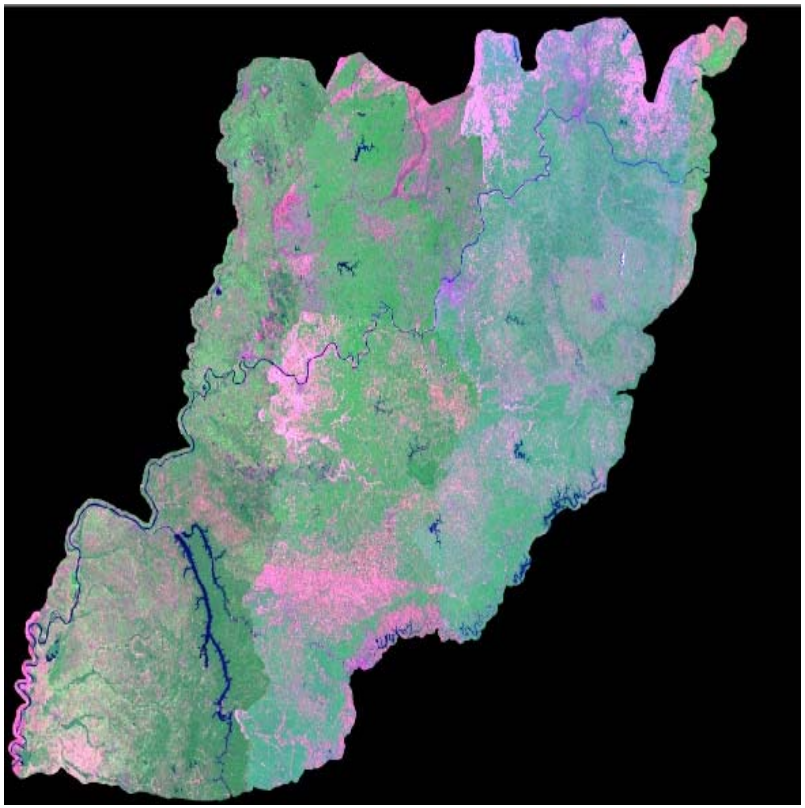
12	Water to Urban
13	Water to Barren
14	Water to Forest
15	Water to Rangeland
16	Water to Agriculture
17	Water to Wetland
21	Urban to Water
22	
23	Urban to Barren
24	Urban to Forest
25	Urbaan to Rangeland
26	Urban to Agriculture
27	Urban to Weltand
31	Barren to Water
32	Barren to Urban
33	
34	Barren to Forest
35	Barren to Rangeland
36	Barren to Agriculture
37	Barren to Wetland

41	Forest to Water
42	Forest to Urban
43	Forest to Barren
44	
45	Forest to Rangeland
46	Forest to Agriculture
47	Forest to Wetland
61	Agriculture to Water
62	Agriculture to Urban
63	Agriculture to Barren
64	Agriculture to Forest
65	Agriculture to Rangelan
66	
67	Agriculture to Wetland
71	Wetland to Water
72	Wetland to Urban
73	Wetland to Barren
74	Wetland to Forest
75	Wetland to Rangeland
76	Wetland to Agriculture

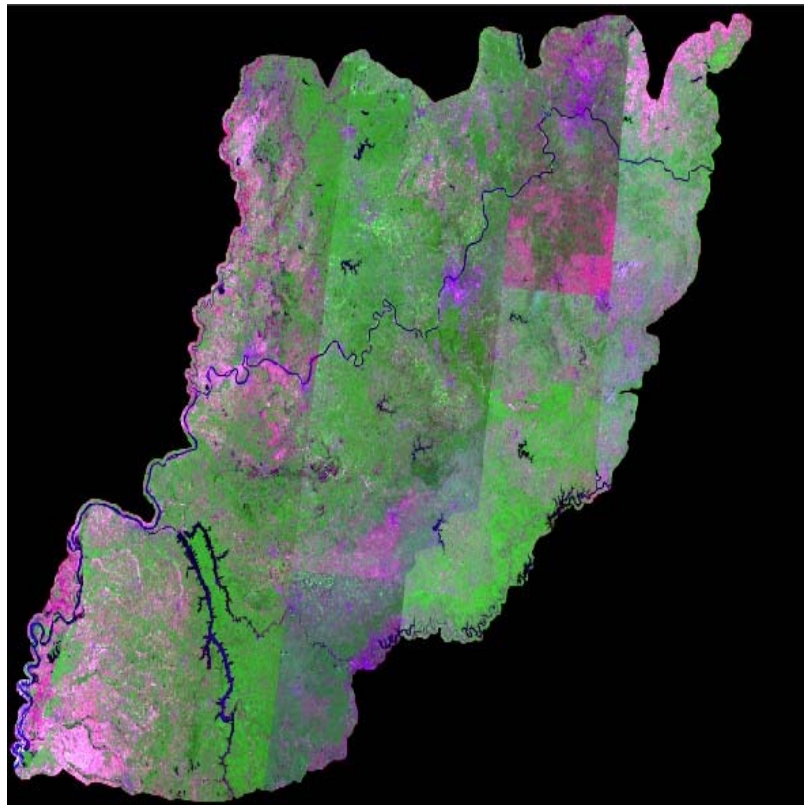
NLCD Land Cover Change Product: Zones 16,36,47,53,60.



Zone 47 (Western Kentucky) -

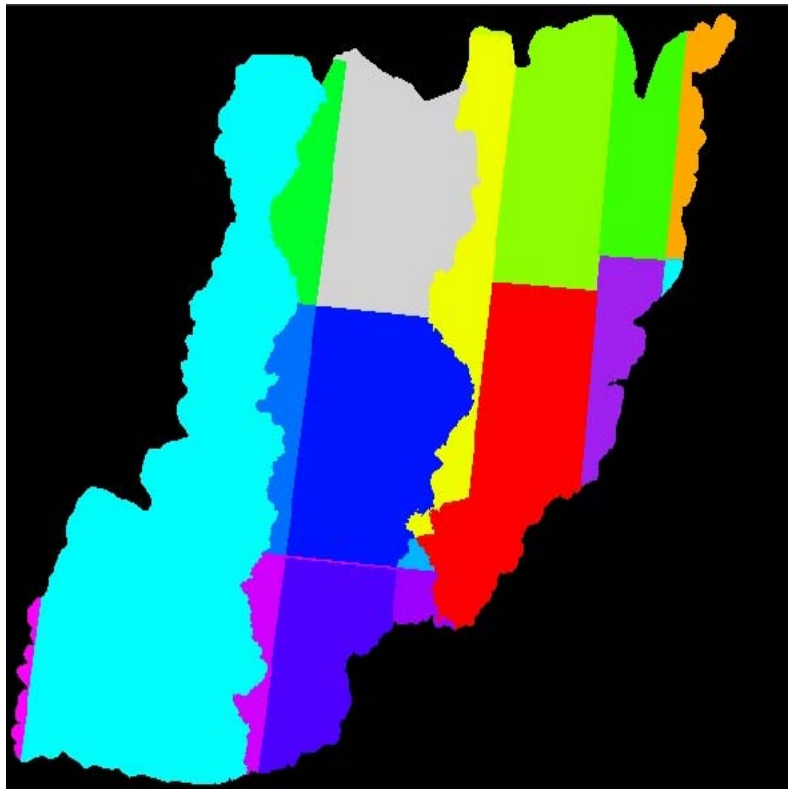


‘92 Era Landsat 5
Reflectance Mosaic

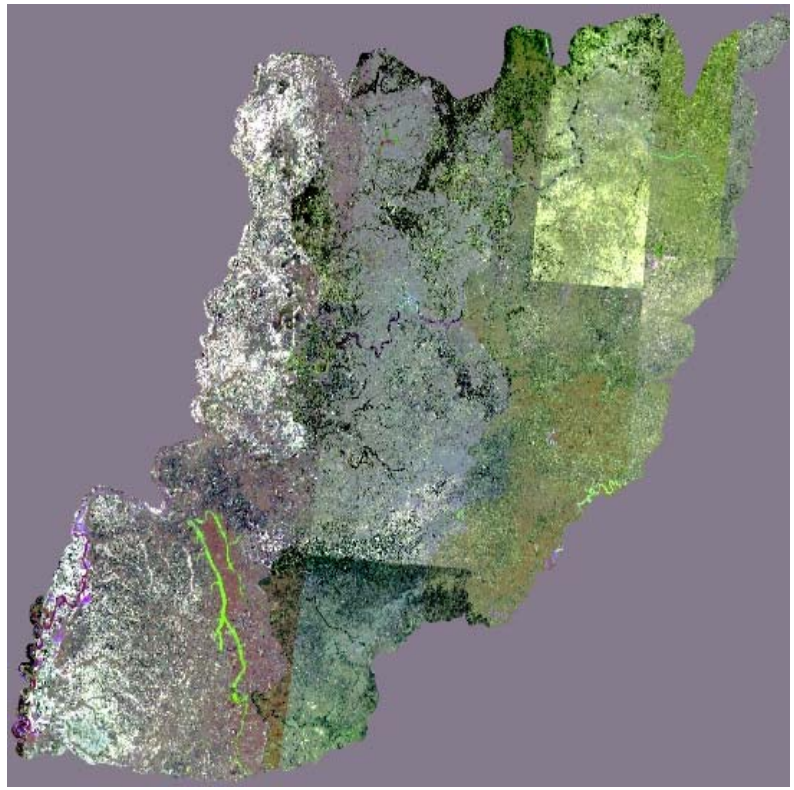


‘01 Era Landsat 7
Reflectance Mosaic

Zone 47: Spatial, Temporal, and Spectral Characteristics



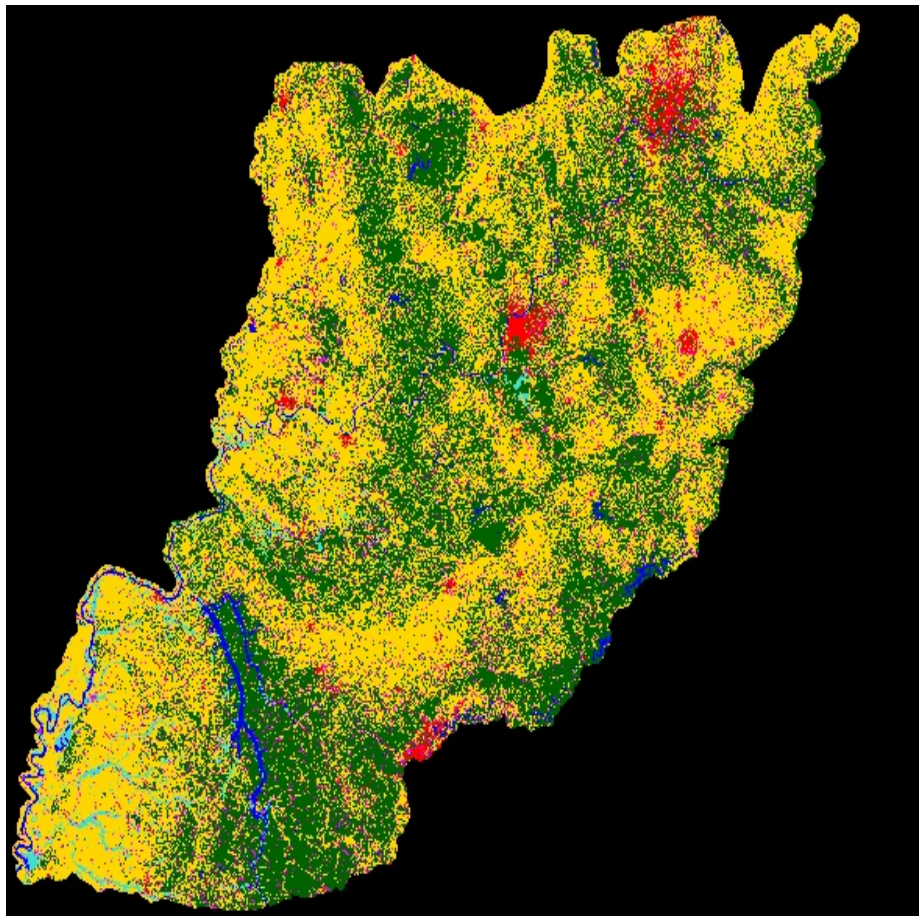
Spatio-Temporal Mosaic



Spectral Difference Mosaic

Zone 47: Zone Wide, Wall-to-Wall, Change Product

NLCD Change product: Nominal Anderson Level 1, assembled from all intermediate reclassifications, and a final voting process to determine type of change (from-to).



Process uses all input layers:

- **Two dates of land cover**
- **Two dates of imagery**
- **Spatio-temporal mosaic**
- **Spectral-difference mosaic**

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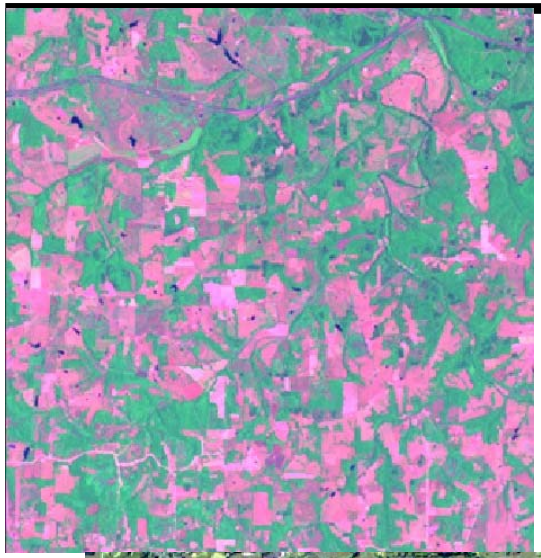
Example 1: New Highway



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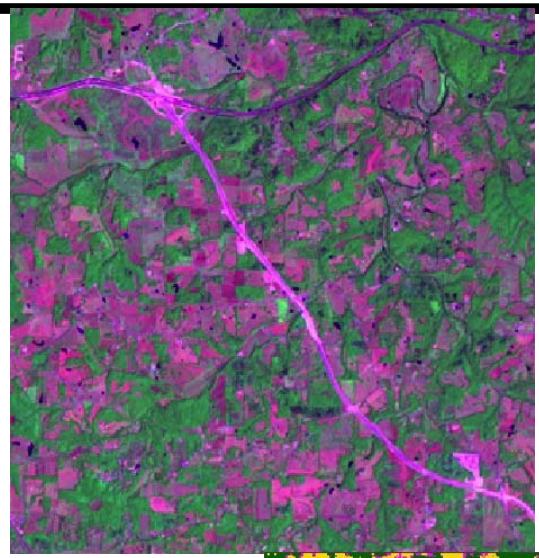

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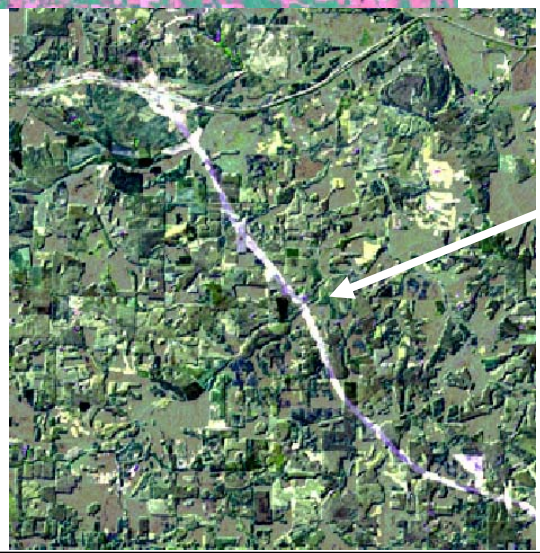
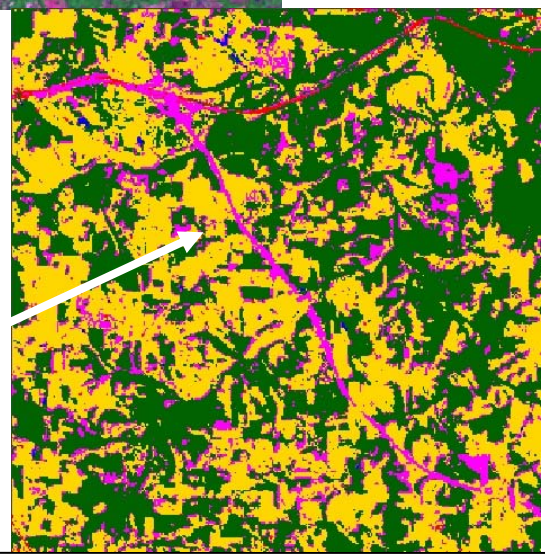
NOTE: All Image Chips are 10 km sq (~6 miles sq)

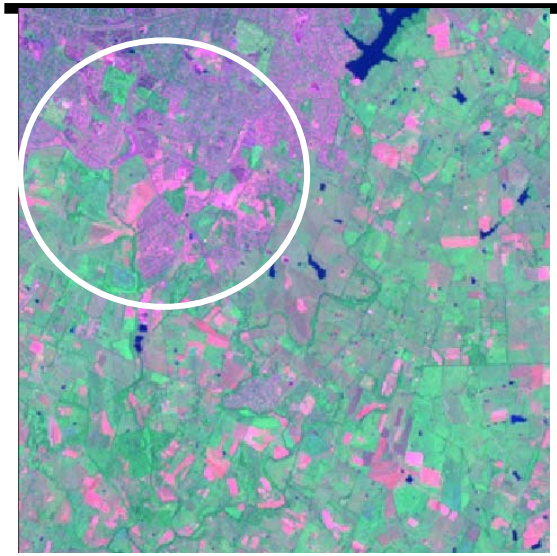


Spectral changes

Land cover changes (magenta)



Example 2: Agriculture to Urban



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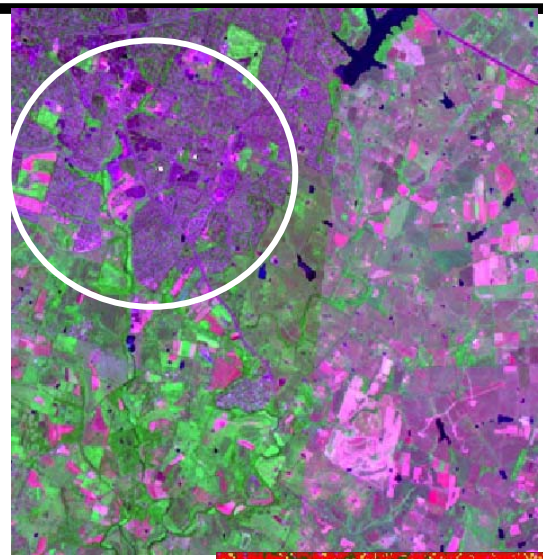

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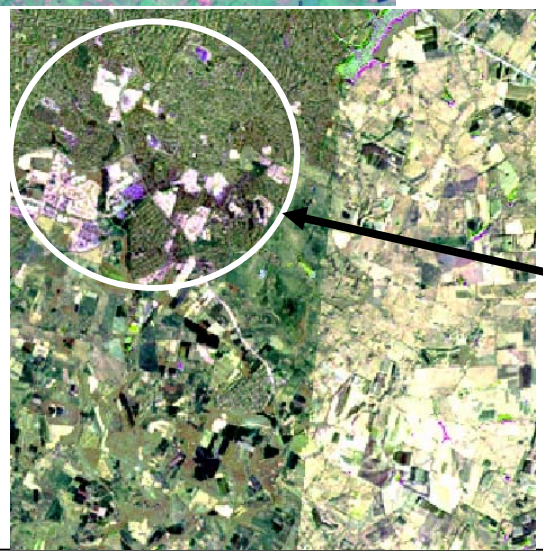
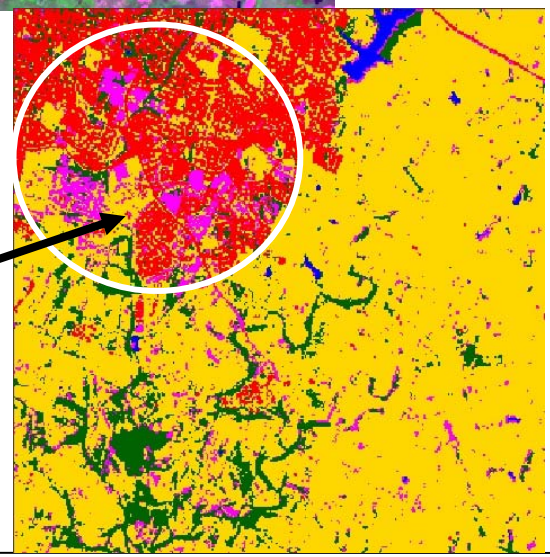


New Urban



Example 3: Flooded Agriculture

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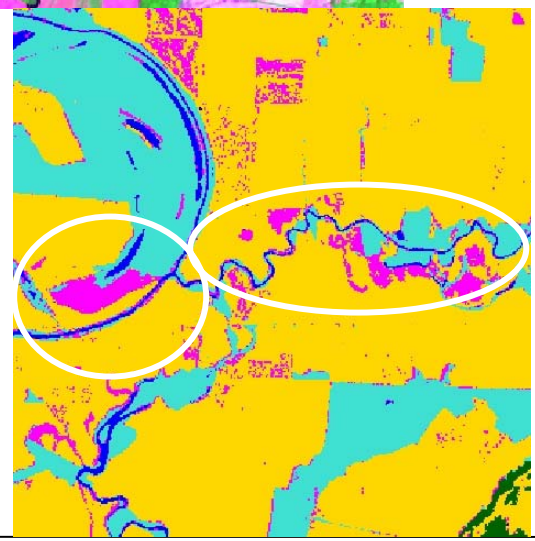

Example 4: Agriculture (No Change)

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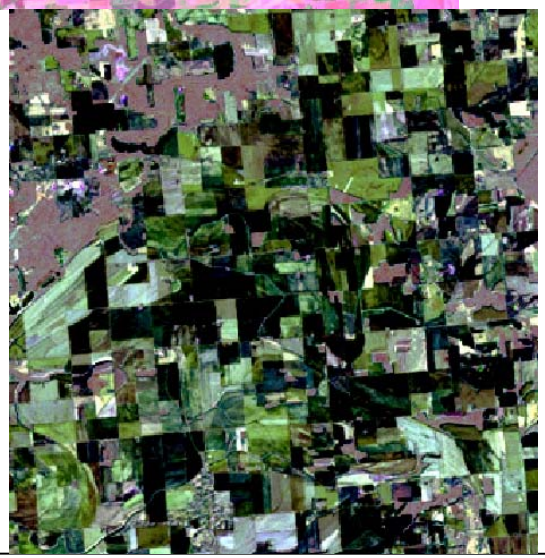
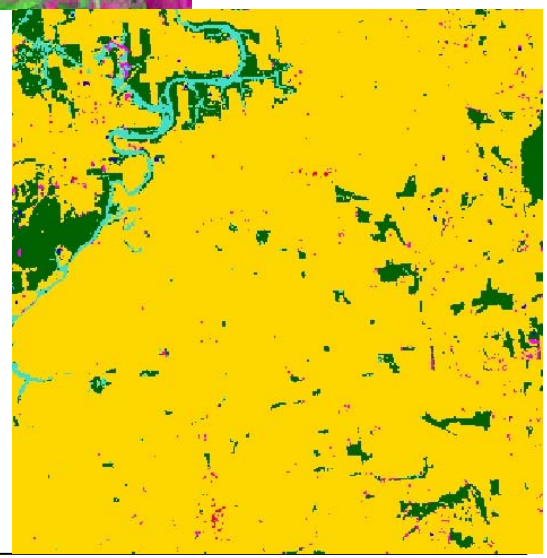
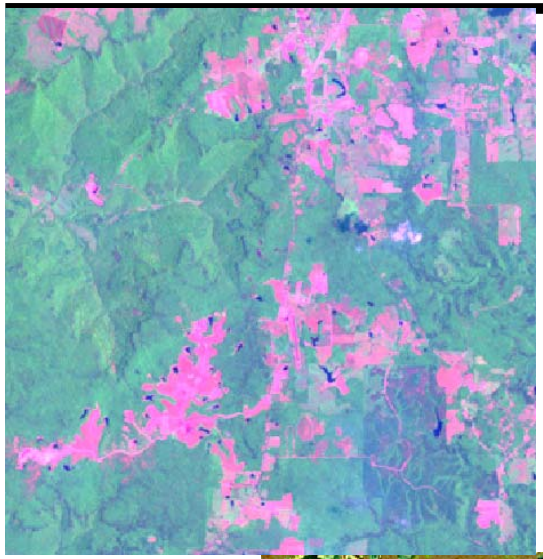


Major spectral differences due to normal phenology and agricultural uses, but *not* seen as meaningful “change” at Anderson Level 1.



Zone 53 (Eastern Kentucky) - Example 1: Logging, New Roads



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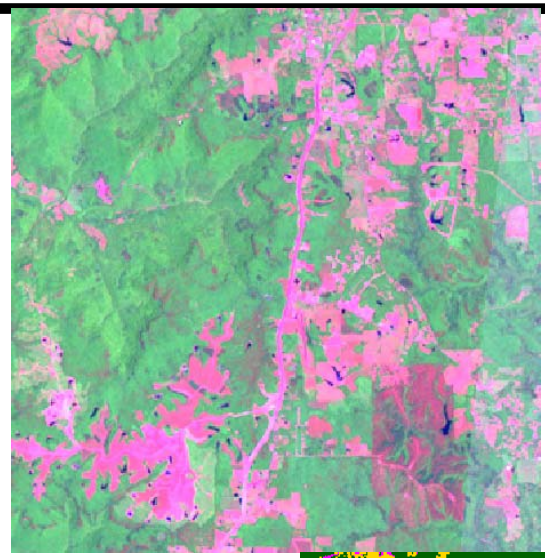

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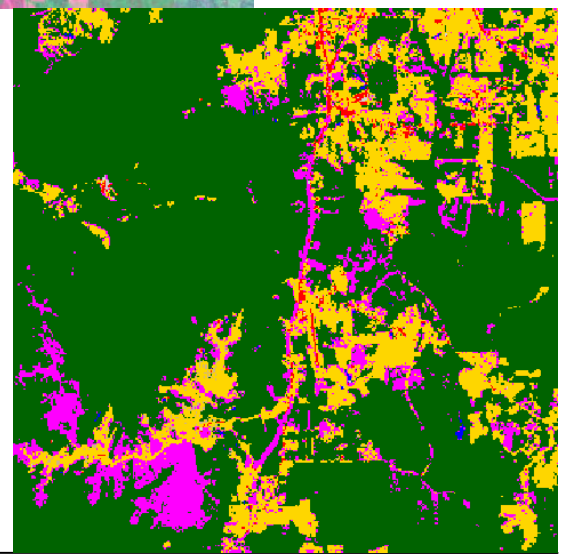
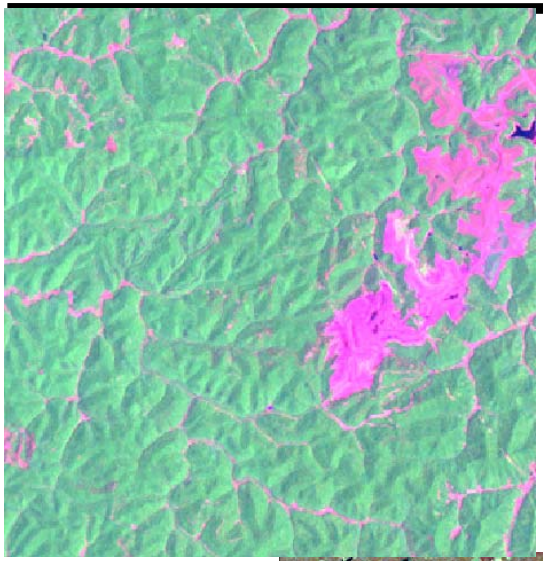


Example 2: Mountain Top Mining



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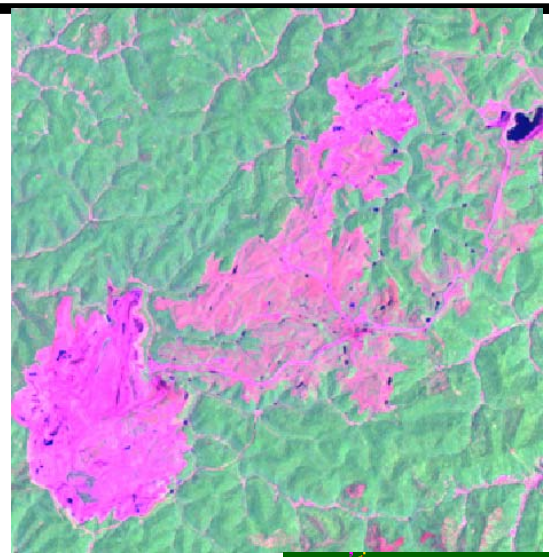

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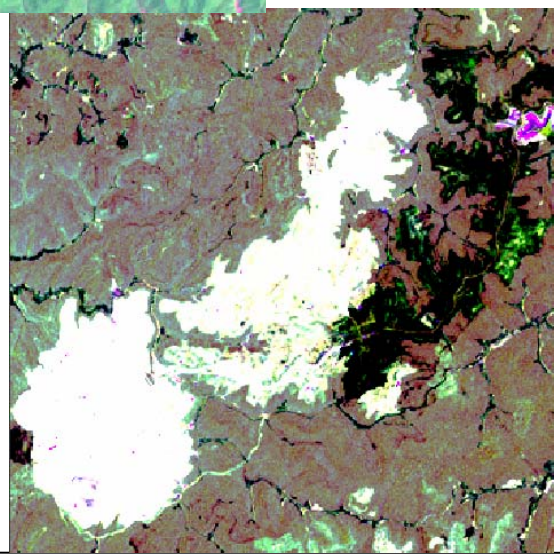
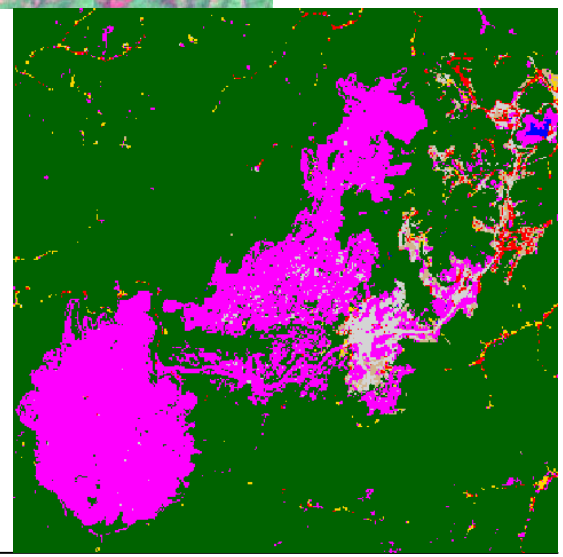
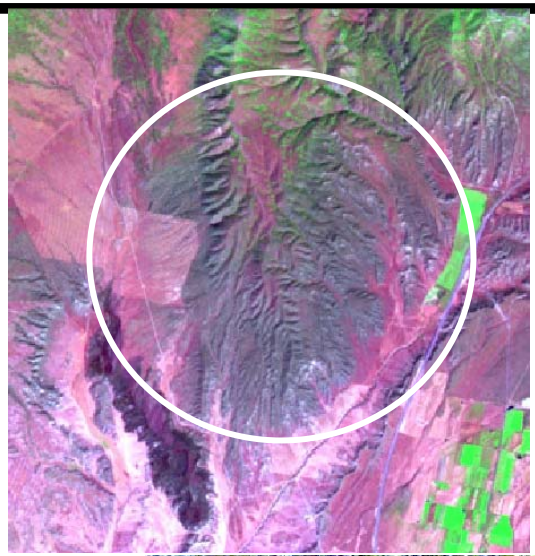
NOTE: All Image Chips are 10 km sq (~6 miles sq)





Zone 16 (Central Utah) – Example 1: Fire Scar



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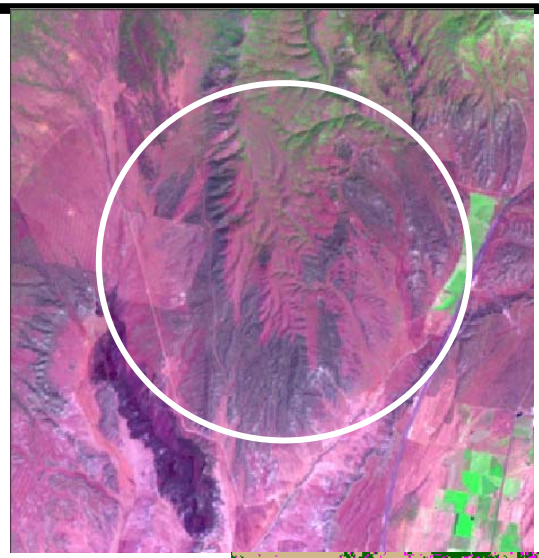

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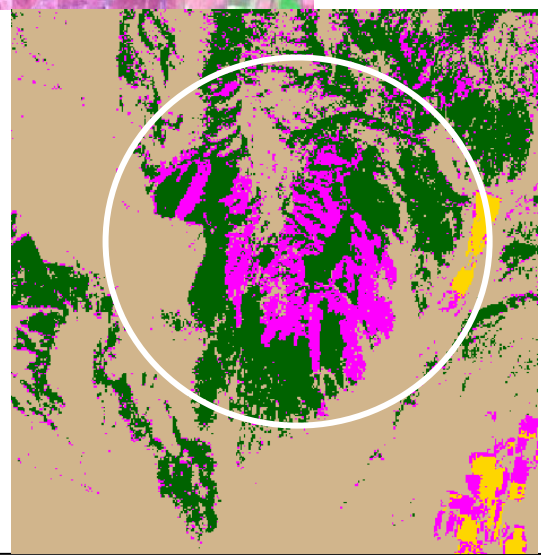

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Example 2: Logging

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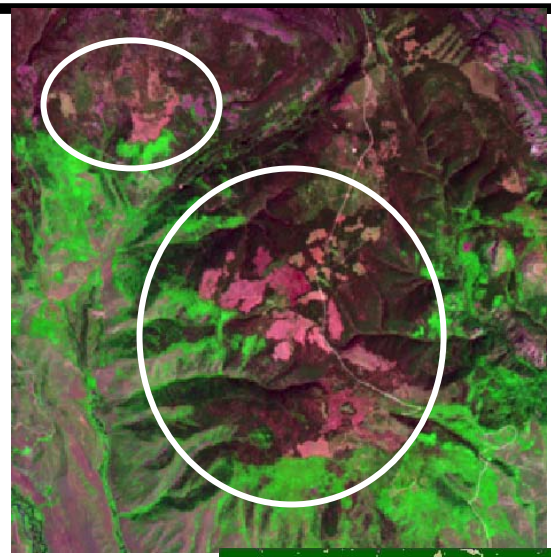

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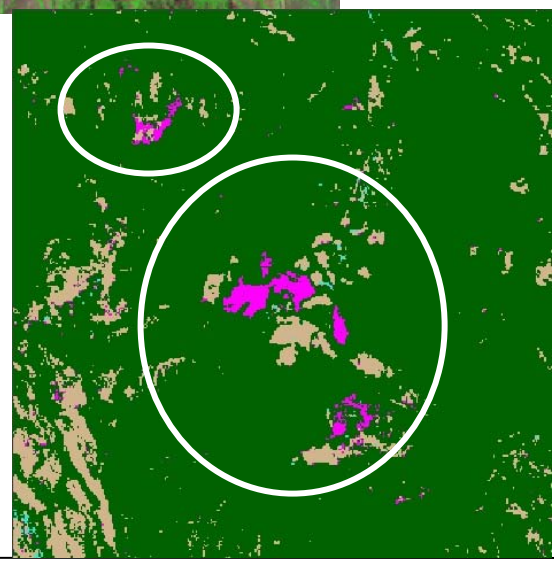
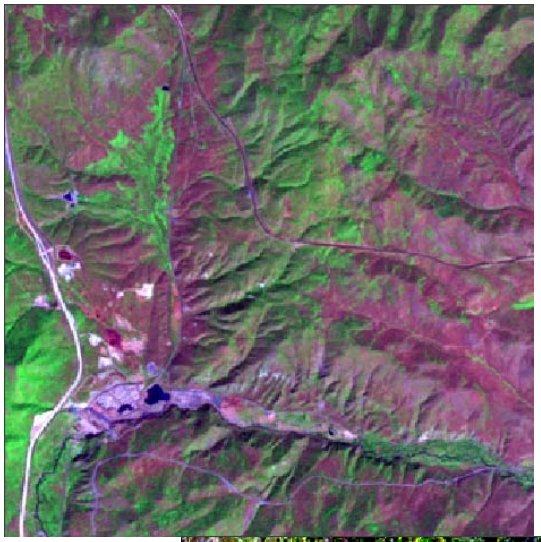


Example 3: New Reservoir



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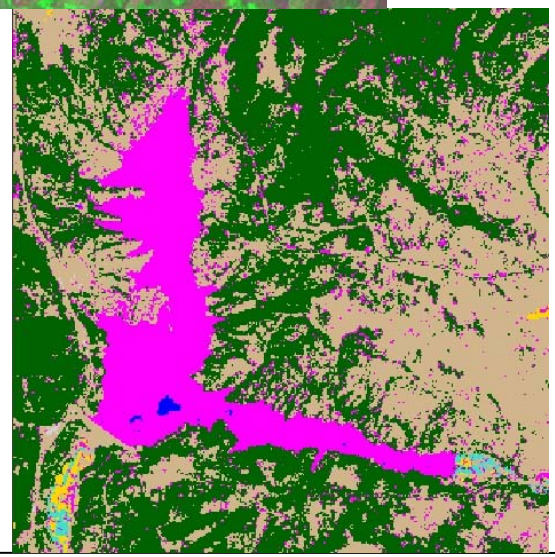
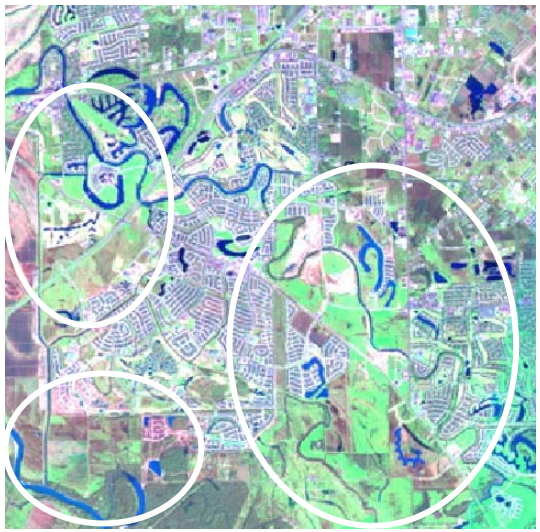


Zone 36 (East Texas) – Example 1: Suburban Development



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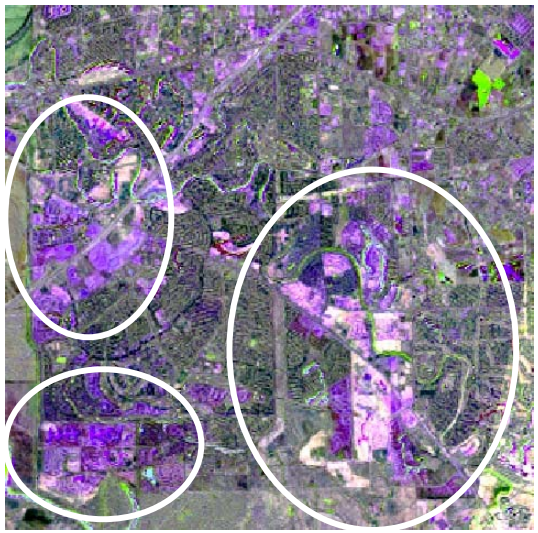

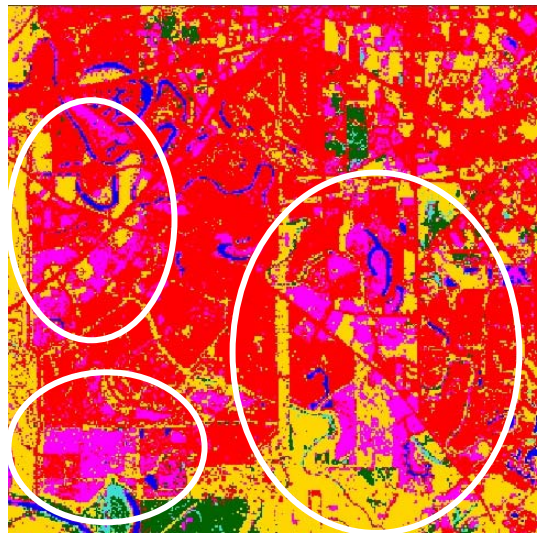

Example 2: Water-wetlands Complex

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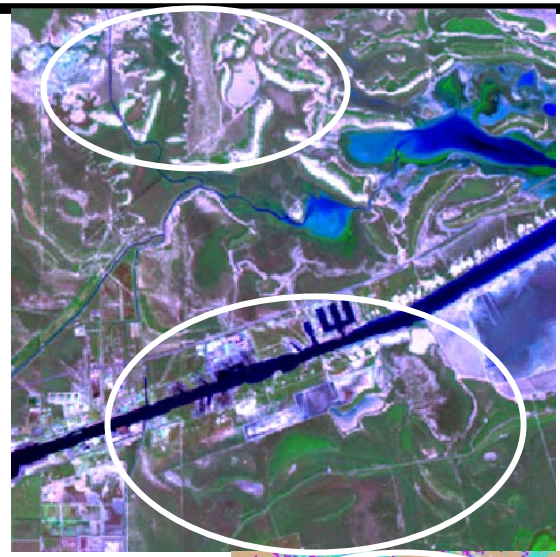

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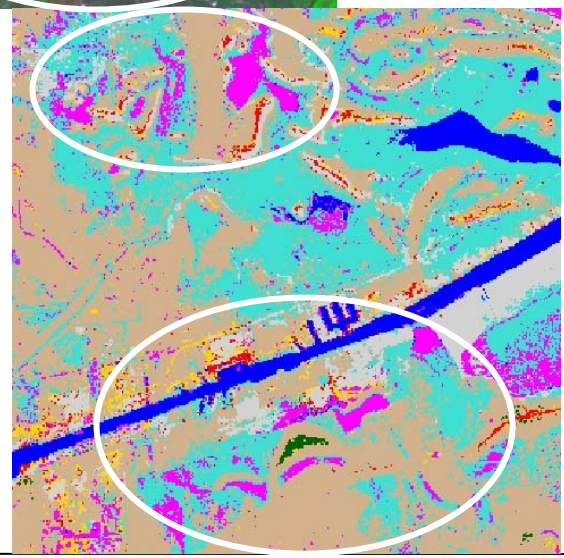
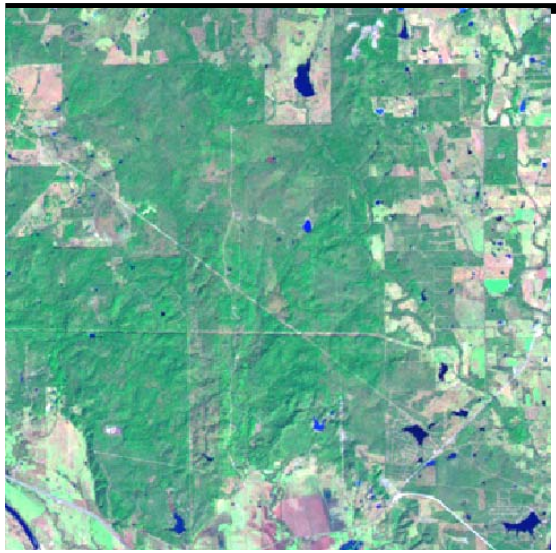


Example 3: Forest Cut



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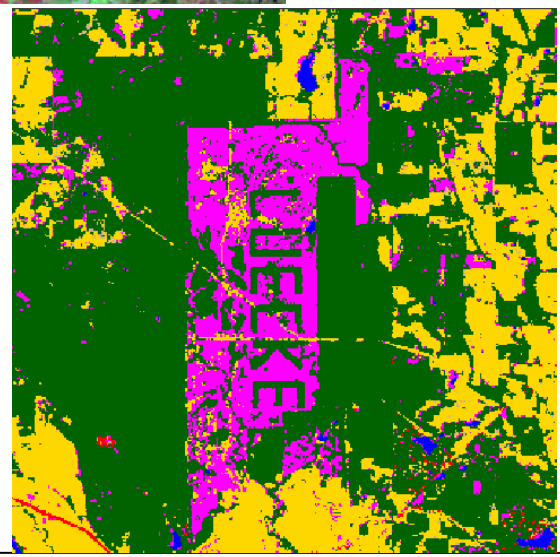
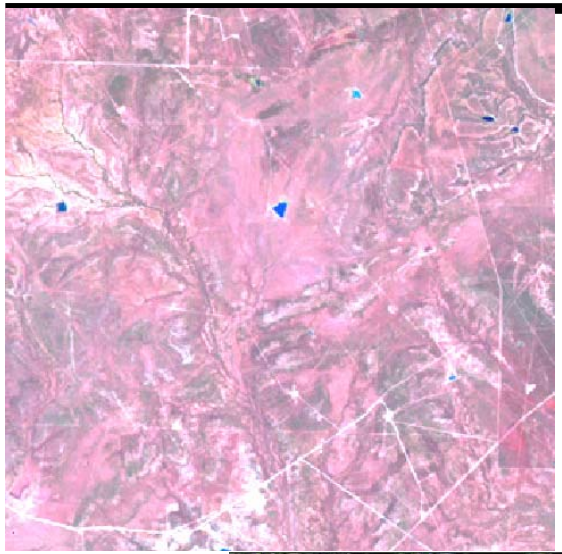
NOTE: All Image Chips are 10 km sq (~6 miles sq)



Example 4: Rangeland Clearing



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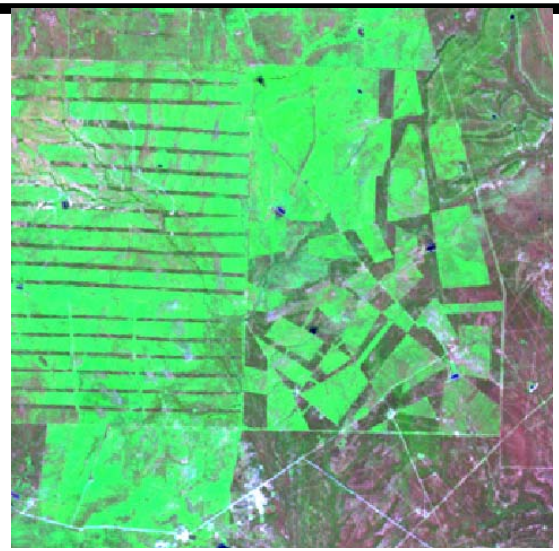
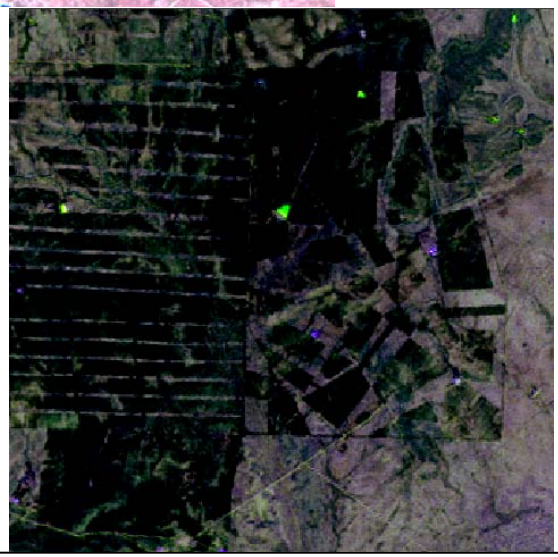
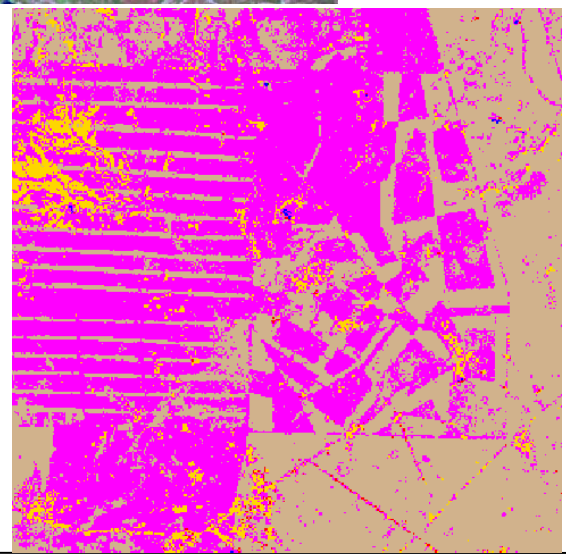


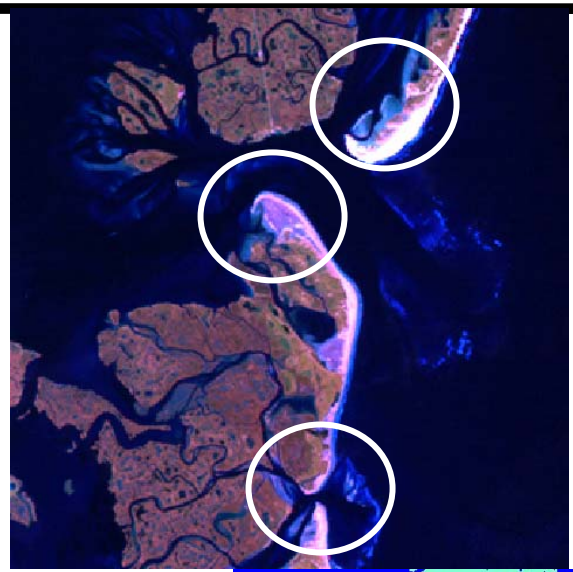
‘01





Zone 60 (Mid-Atlantic Coast)-
Example 1: Shoreline Erosion/Accretion

‘92



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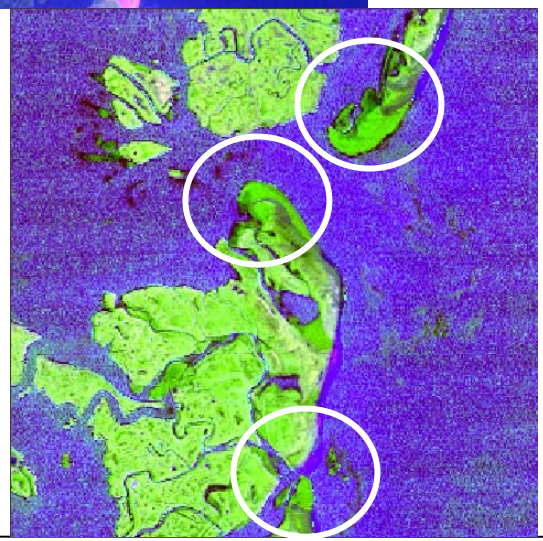
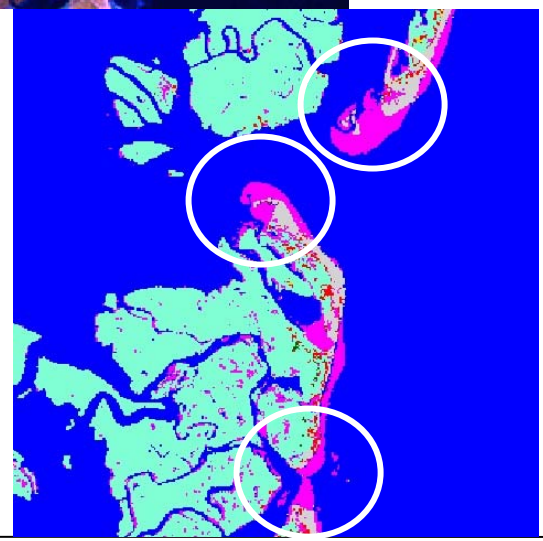
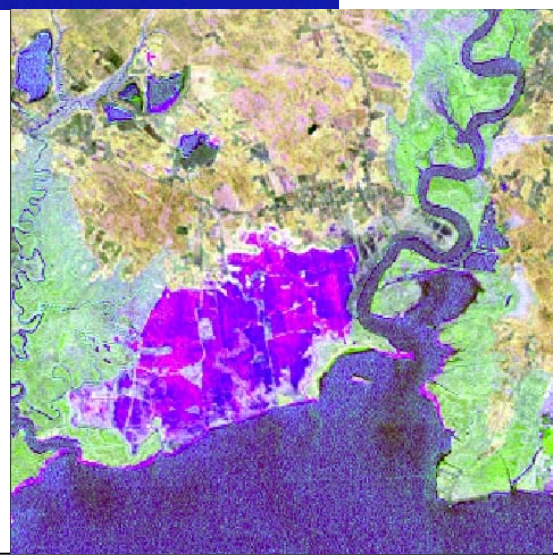


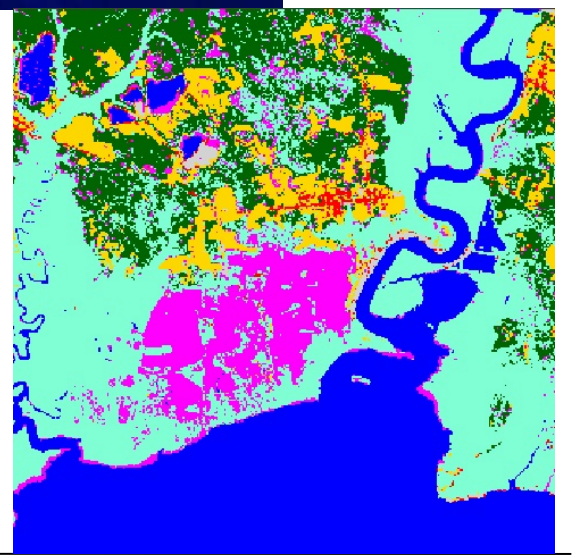


Example 2: Coastal Flooding

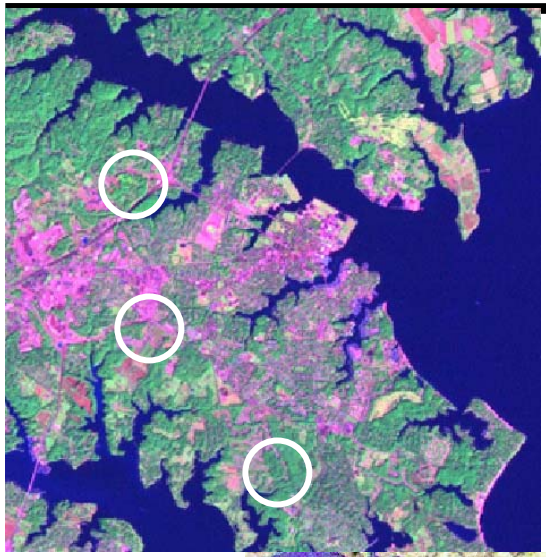
‘92

‘01





Example 3: Urban Growth



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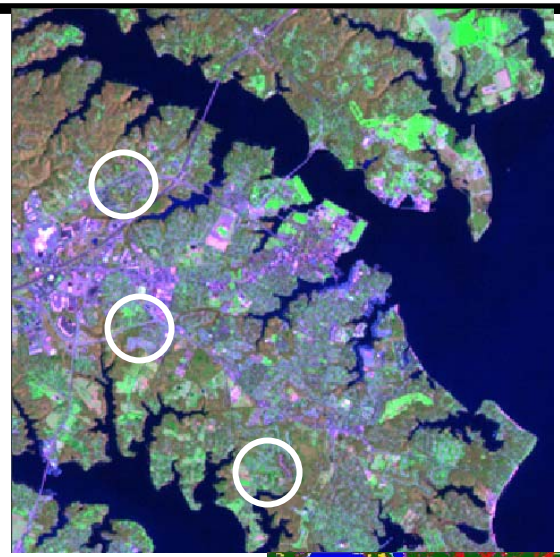

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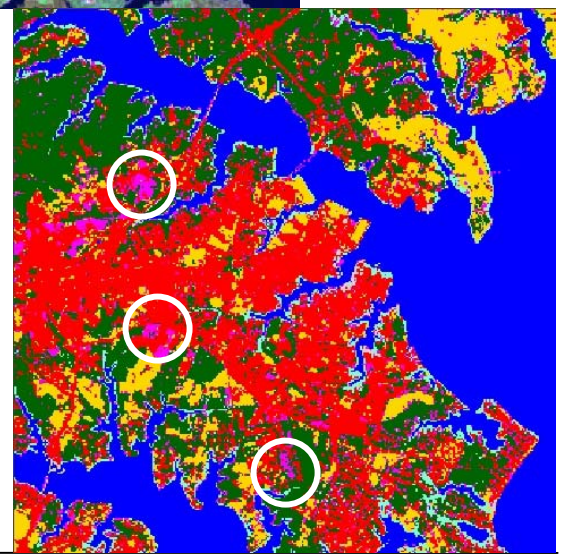

Evaluation of Land Cover Change Product

Preliminary in-house testing performed on 16 individual 7.5 minute Quadrangles, in both Zones 16 and 47 (UT and KY).

Evaluation consisted of a skilled manual interpretation of clusters generated from the spectral difference product.

Results:

Zone 16 (7 Quads)	**Agree No Change**	**= 78%**
	Agree Change	**= 05%**
	Disagree Change/No Change	**= 17%**
Zone 47 (9 Quads)	**Agree No Change**	**= 85%**
	Agree Change	**= 02%**
	Disagree Change/No Change	**= 13%**

Indicates an ~85% agreement between change product method and a manual interpretation of "meaningful" change.

USGS

Possible Tier of Products-

Tier 1: **available via web to the public, the change map of unchanged pixels, and estimated"From-To" values for changed pixels, with associated spatio-temporal metadata.**

Tier 2: **available by request, as above, with the spectral-differencing product.**

Tier 3: **available upon special request, as above, with the image mosaics of both dates, along with the intermediate Anderson Level 1 classifications and confidence maps.**